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INTERNATIONAL APPLICATION DISCLOSED  
BASED ON PATENT COOPERATION TREATY INTERNATIONAL PATENT

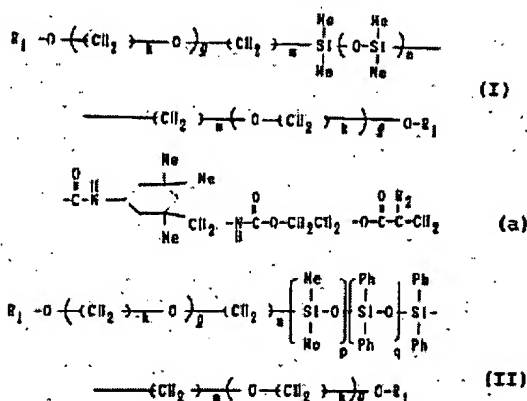


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(21) International Filing No.: PCT/JP90/01736 (22) International Application Date: December 28, 1990 (30) Priority Data: No: Japanese Patent Application No. Hei 1[1990]-342438 Date: December 29, 1989 Country: Japan (71) Applicant (for all the designated countries except for USA): Hoya Corporation 2-7-5 Nakaochiai, Shinzuku-ku, Tokyo-to (postal code: 161) (72) Inventor: (75) Inventors/applicants (only for USA): Yuuichi Yokoyama 24-304, Eikimae Plaza No. 2, 2-15-1 Akamidai, Konosu-shi, Saitama-ken (postal code: 365)  Hidetoshi Iwamoto 1263-9 Nanahonki, O-aza, Kamisato-cho, Kodama-gun, Saitama-ken (postal code: 369-03) (74) Agent: Shizuo Nakamura, patent attorney Kunitake Building 4F, 3-4-11 Iwamoto-cho, Chiyoda-ku, Tokyo-to (postal code: 101)		(81) Designated Countries: AT (European Patent), AU, BE (European Patent), CH (European Patent), DE (European Patent), DK (European Patent), ES (European Patent), FR (European Patent), GB (European Patent), GR (European Patent), IT (European Patent), JP (European Patent), LU (European Patent), NL (European Patent), SE (European Patent), US

## (54) CONTACT LENS MATERIAL AND CONTACT LENS

Attached Disclosed Documents: International Search Report

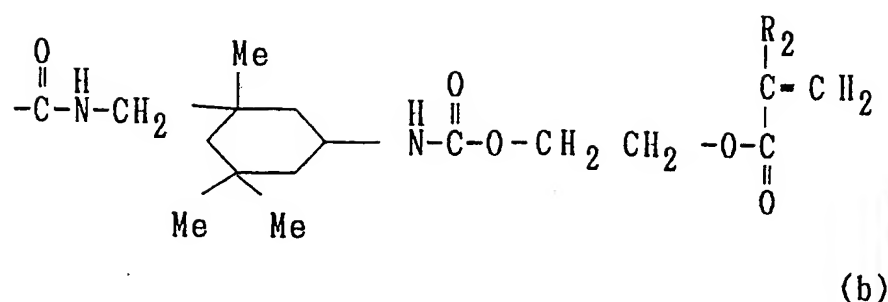
[There are no amendments to this patent.]



## (57) Abstract

A contact lens material comprising a copolymer prepared from a monomer mixture containing as the essential ingredient a siloxane oligomer of formula (I) and/or another siloxane oligomer of formula (II); and a contact lens made from the copolymer (I), wherein  $k$  is an integer of 1 to 3,  $l$  is 0 or 1,  $m$  is an integer of 0 to 3,  $n$  is an integer of 9 to 199, Me represents  $CH_3$ , and  $R_1$  represents (a), wherein  $R_2$  represents H or Me, (II) wherein  $k$  is an integer of 1 to 3,  $l$  is 0 or 1;  $m$  is an integer of 0 to 3,  $p+q$  is an integer of 11 to 139 provided that  $p > 0$  and  $q > 0$ , Me represent  $CH_3$ , Ph represents (b), and  $R_1$  is as defined in formula (I).





(R<sub>2</sub> = H or Me.)

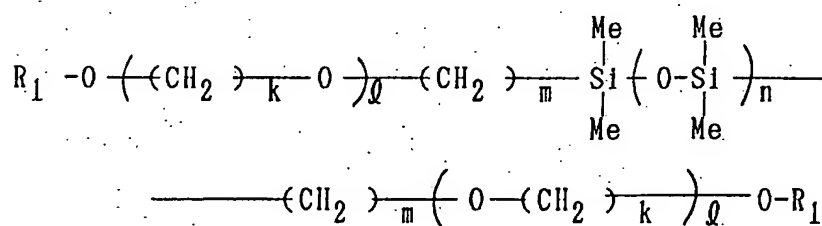
The above-mentioned conventional hard contact lens material has a good oxygen permeability, but since the siloxane oligomer represented by the above-mentioned formula (III) was used, the impact resistance was still not sufficiently satisfactory. The development of a contact lens material in which the oxygen permeability is good and in which the impact resistance is further improved has been in demand.

The present invention solves the above-mentioned problems, and its objective is to provide a contact lens material and a contact lens that have sufficient oxygen permeability and impact resistance required for actual wear.

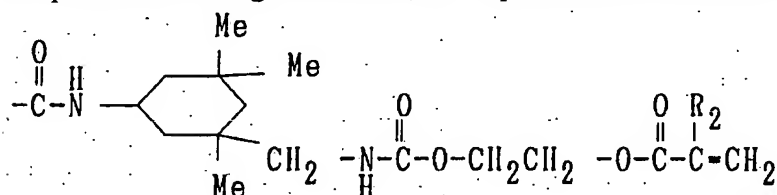
#### Presentation of the invention

The present invention achieves the above-mentioned objective, and its characteristic is a contact lens material composed of a copolymer obtained from a monomer mixture of a siloxane oligomer represented by the following formula (I) and/or a siloxane oligomer represented by formula (II) as essential components, as well as a contact lens obtained by working [processing] the above-mentioned contact lens material.

( I )

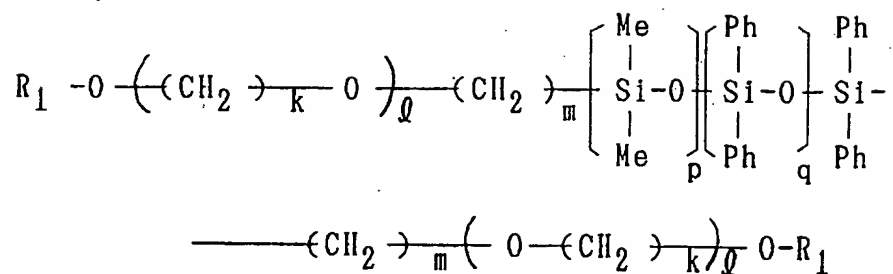


(In the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, n represents an integer of 9-199, Me represents CH<sub>3</sub>, and R<sub>1</sub> represents




(R<sub>2</sub> represents H or Me)).

( II )



(In the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, p + q represents an integer of 11-139 (however, p ≥ 0 and q ≥ 0), Me represents CH<sub>3</sub>, Ph

represents , and R<sub>1</sub> is the same as in formula (I).)

#### Preferred embodiment of the invention

The siloxane oligomers of the above-mentioned formula (I) and/or formula (II) used in the present invention are essential in promoting an action that improves the impact resistance of a contact lens material being obtained, and its molecular weight is preferably in the range of 800-6,000. If the molecular weight is less than 800, a sufficient impact resistance cannot be rendered to the material, and if the molecular weight is more than 6,000, the softness of the material is [adversely] accelerated. More preferably, the molecular weight is in a range of 1,000-5,000.

The amount of said siloxane oligomers used depends on the kinds of monomers used for improving the oxygen permeability, the amount, etc., and it is preferably 0.1-15 wt% (hereinafter, referred to as %). If the amount is more than 15%, the polymerized product is apt to be plastically deformed, and if the amount is less than 0.1%, the improvement effect of the impact resistance cannot be obtained, which is not preferable. The amount is especially preferably 2-11%.

In the present invention, the monomers included along with the above-mentioned siloxane oligomers in the monomer mixture for the copolymer are at least one kind of siloxanyl (meth)acrylate (hereinafter, called Si (M) A) and at least one kind of (meth)acrylate containing fluorine (hereinafter, called F (M) A).

As the Si (M) A used in the present invention, trimethylsiloxydimethylsilylpropyl (meth)acrylate, bis(trimethylsiloxy)methylsilylpropyl (meth)acrylate, tris(trimethylsiloxy)silylpropyl (meth)acrylate, bis[bis(trimethylsiloxy)methylsiloxanyl]trimethylsiloxypropyl (meth)acrylate, bis(trimethylsiloxy)methylsiloxanyl monopentamethyldisiloxanyl

monotrimethylsiloxanylsilylpropyl (meth)acrylate, bis(pentamethyldisiloxane)bis(trimethylsiloxy)methylsiloxanylsilylpropyl (meth)acrylate, etc., can be mentioned; in the present invention, one, two kinds, or more are used together combination.

The Si (M) A is used to render a high oxygen permeability to the contact lens obtained. The amount used is preferably 15-50%. If the amount is less than 15%, it is difficult to obtain the desired oxygen permeability, and if the amount is more than 50%, there is a possibility that the copolymer will be softened. The amount is especially preferably 18-35%, and tris(trimethylsiloxy)silylpropyl methacrylate is preferable.

As the F (M) A used in the present invention, for example, 2,2,2-trifluoroethyl (meth)acrylate, 2,2,2,2',2'-hexafluoroisopropyl (meth)acrylate, 2,2,3,3,4,4,4-heptafluorobutyl (meth)acrylate, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-pentadecafluoro-octyl (meth)acrylate, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,9,9-hexadecafluorononyl (meth)acrylate, perfluoro-octylethyloxypropylene (meth)acrylate, perfluoro-octylethyloxyethylene (meth)acrylate, etc., can be mentioned. In the present invention, one, two kinds, or more of them are used in combination. Since the F (M) A contributes to the improvement of the oxygen permeability of the contact lens material being obtained and is excellent with respect to the compatibility with the siloxane oligomer, the dispersion of the siloxane oligomer is assisted, so that the impact resistance of the contact lens is improved. The amount being used is preferably 15-60%. If the amount is less than 15%, the oxygen permeability is considerably lowered, and if the amount is more than 60%, the contact lens material is softened. Preferably, the amount is 25-52%, and it is more preferable to use two kinds of F (M) A.

In addition to the above-mentioned monomers, the following monomers can be further appropriately added into the monomer mixture provided to the copolymerization in the present invention. As the monomers, for example, an alkyl (meth)acrylate (hereinafter, called R (M) A), hydrophilic monomer, crosslinking monomer, etc., can be mentioned.

The above-mentioned R (M) A can be added to improve the hardness of the contact lens material being obtained. As the R (M) A, for example, methyl methacrylate, ethyl methacrylate, propyl methacrylate, isopropyl methacrylate, butyl methacrylate, cyclohexyl methacrylate, 4-tertiary-butyl cyclohexyl methacrylate, etc., can be mentioned, and one, two kinds, or more of them are used in combination. Its amount being used is preferably 3-20%. If the amount is less than 3%, the hardness improvement effect cannot be obtained, and if the amount is more than 20%, the oxygen permeability is considerably decreased. The amount is especially preferably 4-16%.

The above-mentioned hydrophilic monomer can be added to improve the sense of wear of the lens by raising the water wettability of the contact lens material obtained. As the

hydrophilic monomer, for example, an unsaturated carboxylic acid, unsaturated amide, unsaturated ring-shaped lactam, etc., can be mentioned, and they are used alone or in combinations of two kinds or more. Furthermore, in order to improve the hardness and workability of the contact lens material obtained by improving the compatibility of the siloxane oligomers, the combination of at least one kind of unsaturated carboxylic acid and at least one kind of unsaturated amide may be used.

As the unsaturated carboxylic acid, for example, acrylic acid, methacrylic acid, etc., can be mentioned, and as the unsaturated amide, for example, acrylamide, methacrylamide, N,N-dimethylmethacrylamide, N,N-dimethylacrylamide, etc., can be mentioned. Also, as the unsaturated ring-shaped lactam, for example, pyrrolidone, etc., can be mentioned. The amount of these hydrophilic monomers being used is preferably 2-20%. If the amount is less than 2%, sufficient water wettability and hardness cannot be obtained. Also, if the amount is more than 20%, the oxygen permeability is considerably lowered, and the softness of the copolymer and the turbidity are caused, which is not preferable. The amount is especially preferably 3-16%.

As the above-mentioned crosslinking monomer, a di(meth)acrylate or tri(meth)acrylate of a divalent or polyhydric alcohol, etc., are used. For example, ethylene glycol (meth)acrylate, diethylene glycol di(meth)acrylate, triethylen glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, polyethylene glycol (meth)acrylate, trimethylolpropane tri(meth)acrylate, 2-hydroxy-1,3-dimethacryloxypropane, etc., can be mentioned. Also, an allyl (meth)acrylate may be used. These crosslinking monomers may be used alone or in combinations of two kinds or more. The crosslinking monomers are used to improve the hardness of the contact lens material obtained. The amount of crosslinking monomers being is preferably 0.2-15%. If the amount is less than 0.2%, the contact lens obtained is softened, and if the amount is more than 15%, the material becomes brittle, so that the workability is deteriorated or the lens is damaged. The amount is especially preferably 1.5-8%.

As methods for manufacturing the copolymer for forming the contact lens material of the present invention, well-known polymerization methods can be used, and bulk polymerization is especially preferable. As an initiator being used at that time, peroxides such as lauroyl peroxide, cumene hydroperoxide, and bis-4-tertiary-butylcyclohexyl peroxide and azo compounds such as azobisisobutyronitrile, azobisdimethylvaleronitrile known as general radical initiators can be used; among them, azobisisobutyronitrile is preferable. The amount of polymerization initiator being used is preferably 0.05-0.8% in relation to the total amount of monomers.

For example, the contact lens material of the present invention is obtained in a rod shape or button shape by uniformly mixing the above-mentioned monomer components, casting it into a molding mold of metals, glasses, plastics, etc., sealing it, stepwise or continuously raising the temperature in a temperature range of 25-150°C in an isothermal tank, and finishing the

polymerization for about 5-144 h. Also, it is preferable to carry out the polymerization after substituting the air in the solution by an inert gas such as nitrogen and argon and sealing it. The copolymer as the contact lens material obtained is finished in a lens shape by ordinary working methods of the contact lens, for example, mechanical working such as cutting and polishing. Also, as another manufacturing method of the contact lens of the present invention, a monomer mixture solution can be cast into a mold with a preset radius of curvature and directly molded in a lens shape. Also, a photopolymerization method using ultraviolet rays, etc., can also be adopted as the polymerization process.

Next, application examples of the present invention are shown; however, the present invention is not limited to these application examples. Also, the property values and the indexes of the following application examples and comparative examples were obtained by the following methods.

**Oxygen permeation coefficient:** Using a film oxygen permeability gauge made by Rika Seiki Kogyo K.K., it was measured at a sample thickness of 0.2 mm in a 0.9% physiological saline solution at 35°C.

**Impact resistance test:** A specimen with a diameter of 12 mm and a thickness of 2 mm was prepared, and a fracture test was carried out using a Dyne [transliteration] start tester made by Toyo Seiki Works K.K.; when the energy required for the fracture [breakage] of the polymethyl methacrylate was assumed as 100, it was evaluated as the impact resistance index.

#### Application Example 1

8.6% siloxane oligomer (oligomer of the formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 12$ ) (hereinafter, called S-1), 19.1% tris (trimethylsiloxy)silylpropyl methacrylate (hereinafter, called Si<sub>1</sub>), 41.5% hexafluoroisopropyl methacrylate (hereinafter, called 6F), 10.5% methyl methacrylate (hereinafter, called MMA), 11.6% 4.4% N,N-dimethylacrylamide (hereinafter, called DX), and 4.3% 2-hydroxy-1,3-dimethacryloxypropane (hereinafter, called HDMP) were mixed, and 0.5% azoisobutyronitrile (hereinafter, called AIBN) as a polymerization initiator was added to the total weight of the monomers, so that a uniform solution was formed. It was put into a tube made of polyethylene and sealed; the temperature was continuously raised for 72 h in an isothermal water tank at 42.5°C, and furthermore at 42.5-60°C for 14 h, 60-80°C for 10 h, 80°C for 10 h, 80-100°C for 5 h, 100°C for 10 h, and 100-125°C for 10 h in a hot-air dryer.

The copolymer obtained as a result was colorless, transparent, and optically uniform; it was also excellent in mechanical workability such as cutting and polishing. As a result of the measurement of the properties of the copolymer, the oxygen permeation coefficient was  $39 \times 10^{-11}$  [mL O<sub>2</sub> (STP) cm/cm<sup>2</sup> · sec · mm Hg], and the impact resistance index was 88. Thus, it was clarified that the contact lens material had good oxygen permeability and excellent impact resistance.

### Application Examples 2-33

Using various kinds of monomer compositions and mixture ratios shown in Table I, copolymers of each application example were manufactured by a method similar to that of the above-mentioned Application Example 1. For the copolymers of each application example, the oxygen permeation coefficient and the impact resistance index were measured. The results are shown in Table I.

### Comparative examples

Using various kinds of monomer compositions and mixture ratios shown in Table I, copolymers of each comparative example were manufactured by a method similar to the application examples. For the copolymers of each comparative example, the oxygen permeation coefficient and the impact resistance index were measured. The results are shown in Table I.

Also, the abbreviations used in the application examples and the comparative examples mean the following compounds.

SIOL: Siloxane oligomer

S-1: Oligomer of formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 12$

S-2: Oligomer of formula (I),  $R_2 = H$ ,  $l = 0$ ,  $m = 0$ , and  $n = 12$

S-3: Oligomer of formula (I),  $R_2 = CH_3$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 13$

S-4: Oligomer of formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 21$

S-5: Oligomer of formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 55$

S-Z: Oligomer of formula (III),  $R_3 = (b)$ ,  $R_2 = H$ , and  $t = 13$

Si (M) A: Siloxanyl (meth)acrylate

Si<sub>1</sub>: Tris(trimethylsiloxy)silylpropyl methacrylate

Si<sub>2</sub>: Bis(trimethylsiloxy)methylsilylpropyl methacrylate

Si<sub>3</sub>: Trimethylsiloxydimethylsilylpropyl methacrylate

Si<sub>4</sub>: Pentamethyldicyloxanylmethyl methacrylate

F (M) A: (Meth)acrylate containing fluorine

6F: Hexafluoroisopropyl methacrylate

3F: 2,2,2-trifluoroethyl methacrylate

FOMA: Perfluoro-octylethyloxypropylene methacrylate

FOIMA: Perfluoro-octylethyloxyisopropylene methacrylate

FOEMA: Perfluorooctylethyloxyethylene methacrylate

R (M) A: Alkyl (meth)acrylate

MMA: Methyl methacrylate

IPMA: Isopropyl methacrylate

CHMA: Cyclohexyl methacrylate

MA: Methacrylic acid



DX: N,N-dimethylacrylamide

HDMP: 2-hydroxy-1,3-dimethacryloxypropane

TMPT: Trimethylolpropane trimethacrylate

1G: Ethylene glycol dimethacrylate

3G: Triethylene glycol dimethacrylate

Table I

			Application Example										
			1	2	3	4	5	6	7	8	9	10	11
Monomer composition (wt%)	S I O L	S-1	8.6	8.8	8.7				8.7	11	3		5
		S-2					8.7						
		S-3						8.7					
		S-4				8.7							
		S-5										5.8	
		S-Z(*1)											
	S i (M) A	S i <sub>1</sub>	19.1	19.5	20	20	20	19.7	19.7	17	25	22	30
		S i <sub>2</sub>											
		S i <sub>3</sub>											
		S i <sub>4</sub>											
	F (M) A	6F	41.5	42.4	43	43	43	37	37	35	34	37.5	
		3F						13	13	10	13	7	40
		FOMA											
		FOIMA											
		FOEMA											
	R (M) A	MMA	10.5	10.6	11	11	11	4.3	4.3	14.5	12	12	12
		I PMA											
		CHMA											
	Hydrophilic monomer	MA	11.6	9.8	8.7	8.7	8.7	8.7	8.7	5.3	6	8.7	5
		DX	4.4	4.5	4.3	4.3	4.3	4.3	4.3	3.7	4	4.5	5
	Crosslinking monomer	HDMP	4.3	4.4	4.3	4.3	4.3	4.3	4.3	3.5	3	2.5	
		TMPT											
		1 G											3
		3 G											
Properties	Oxygen permeation coefficient (*2)		39	40	38	37	40	38	37	35	44	43	42
	Impact resistance index		88	85	82	84	85	87	85	84	81	83	81

\*1: Conventional siloxane oligomer

\*2:  $2 \times 10^{-11}$  [mL O<sub>2</sub> (STP) cm/cm<sup>2</sup> · sec · mm Hg]

Table I (continued)

			Application Example										
			12	13	14	15	16	17	18	19	20	21	22
Properties	Monomer composition (wt%)	S-1	5	5	9	10		8		2	8	9	8
		S-2											
		S-3					1						
		S-4							15				
		S-5											
		S-Z (*1)											
	S i (M) A	S i <sub>1</sub>	25	22	25	25	25	31	15	45	30	40	31
		S i <sub>2</sub>											
		S i <sub>3</sub>											
		S i <sub>4</sub>											
	F (M) A	6F		38	49	50							
		3F	50										
		FOMA					23	33	50	10	30	19	
		FOIMA											30
		FOEMA											
	R (M) A	MMA		15		10	25	15	8	28	16	20	16
		IPMA											
		CHMA											
	Hydrophilic monomer	MA	10	10	12		9	8	8	9	8	4	8
		DX	5				5	5	4	4.5	4	2	4
	Crosslinking monomer	HDMP			5							6	
		TMPT		10		5					4		3
		1G	5							1.5			
		3G											
	Oxygen permeation coefficient (*2)		42	51	59	52	37	40	49	35	40	36	41
	Impact resistance index		82	76	75	78	76	77	60	78	84	80	85

\*1: Conventional siloxane oligomer

\*2:  $2 \times 10^{-11}$  [mL O<sub>2</sub> (STP) cm/cm<sup>2</sup> · sec · mm Hg]

Table I (continued)

			Application Example										
			23	24	25	26	27	28	29	30	31	32	33
Monomer composition (wt%)	S I O L	S-1	8		8	7	3	5	8	9	8		7
		S-2											
		S-3		9								7.5	
		S-4											
		S-5											
		S-Z (*1)											
	S i (M) A	S i <sub>1</sub>	35	30	32	40	32	32	25				23.5
		S i <sub>2</sub>								20			
		S i <sub>3</sub>									25		
		S i <sub>4</sub>										30	
	F (M) A	6 F							25		34.5		20
		3 F								25		35	
		F O M A		31	25								
		F O I M A	20				30	29	10	15			
		F O E M A				20							15
	R (M) A	M M A	20			18	22	21	17				20
		I P M A		15							15		
		C H M A			17					15		10.5	
	Hydrophilic monomer	M A	9	9	11	10	8	8	8	9	9	9	8
		D X	5	3	3	3	2.5	2.5	3	3	4	4.5	3.5
	Crosslinking monomer	H D M P							4				
		T M P T									4.5		3
		1 G	3	3	4	2				4		3.5	
		3 G					2.5	2.5					
Properties	Oxygen permeation coefficient (*2)		38	49	47	39	40	43	35	33	40	34	34
	Impact resistance index		81	80	79	79	82	81	78	80	82	85	86

\*1: Conventional siloxane oligomer

\*2:  $2 \times 10^{-11}$  [mL O<sub>2</sub> (STP) cm/cm<sup>2</sup> · sec · mm Hg]

Table I (continued)

			Comparative Example							
			1	2	3	4	5	6	7	8
Monomer composition (wt%)	S I O L	S - 1								
		S - 2								
		S - 3								
		S - 4								
		S - 5								
		S - Z (*1)	5	5	5	7	10			4.8
	S i (M) A	S i <sub>1</sub>	30	25	22	43	30	24	21.9	19
		S i <sub>2</sub>								
		S i <sub>3</sub>								
		S i <sub>4</sub>								
	F (M) A	6 F			38			56	65.8	28.6
		3 F	40	50		43	45			
		F O M A								
		F O I M A								
		F O E M A								
	R (M) A	M M A	12		15		10	8		28.6
		I P M A								
		C H M A								
	Hydrophilic monomer	M A	5	10	10	5		8	8.8	9.5
		D X	5	5					1.75	
	Crosslinking monomer	H D M P						4	1.75	
		T M P T			10		5			9.5
		1 G	3	5		2				
		3 G								
Properties	Oxygen permeation coefficient (*2)		45	42	49	55	40	60	67	21
	Impact resistance index		64	62	63	60	67	55	40	70

\*1: Conventional siloxane oligomer

\*2:  $2 \times 10^{-11}$  [mL O<sub>2</sub> (STP) cm/cm<sup>2</sup> · sec · mm Hg]

As seen from Table I, in the copolymers of Application Examples 1-33 containing the siloxane oligomers of the present invention: S-1 (oligomer of the formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 12$ ), S-2 (oligomer of the formula (I),  $R_2 = H$ ,  $l = 0$ ,  $m = 0$ , and  $n = 12$ ), S-3 (oligomer of the formula (I),  $R_2 = CH_3$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 13$ ), S-4: (oligomer of the formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 21$ ), S-5 (oligomer of the formula (I),  $R_2 = H$ ,  $k = 3$ ,  $l = 1$ ,  $m = 3$ , and  $n = 55$ ), a large impact resistance index is obtained, compared with the copolymers of Comparative Examples 1-5 containing the siloxane oligomer used in the prior art: S-Z (oligomer of the formula (III),  $R_3 = (b)$ ,  $R_2 = H$ , and  $t = 13$ ). Also, the oxygen permeability of the copolymers of Application Examples 1-33 were good.

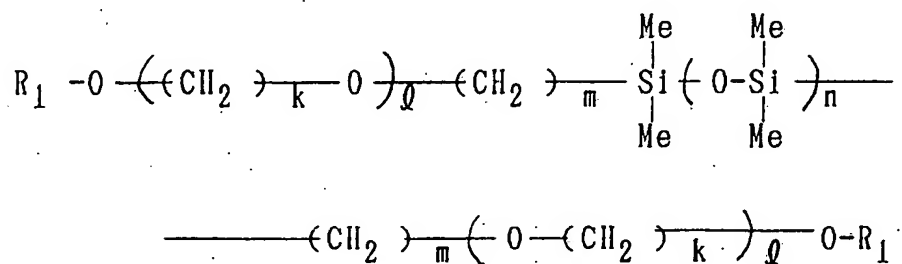
Furthermore, in the present invention, the actions of each added monomer are exerted in a multiplied fashion [multiplicative manner] in the contact lens materials of each application example in which an alkyl (meth)acrylate, hydrophilic monomer, and crosslinking monomer are added, and excellent advantages (for example, hardness, water wettability, etc.) are obtained. Any of these application examples provides excellent properties.

As mentioned above in detail, according to the contact lens material of the present invention, since specific siloxane oligomers are used, a contact lens with an oxygen permeability required for actual wearing of the contact lens and an impact resistance superior to that of the prior art can be obtained. Therefore, according to the present invention, since the generation rate of lens damage during handling can be reduced and the durability of the lens can be raised, the safety and the economical efficiency of the contact lens can be improved, and the contact lens is very useful for actual wearing.

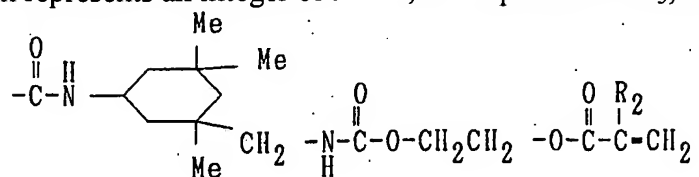
### Claims

1. A contact lens material, characterized by being composed of a copolymer obtained from a monomer mixture of a siloxane oligomer represented by the following formula (I) and/or a siloxane oligomer represented by formula (II) as essential components, as well as a contact lens obtained by working the above-mentioned contact lens material:

( I )

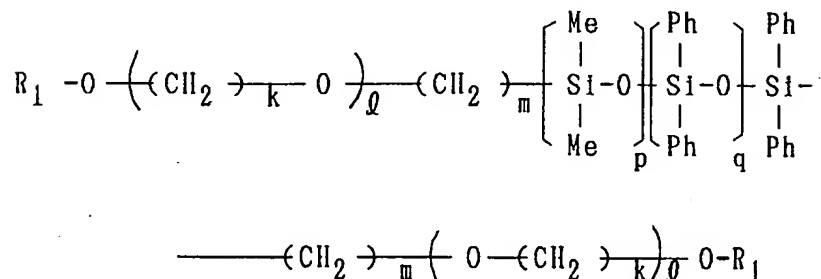


(in the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, n represents an integer of 9-199, Me represents CH<sub>3</sub>, and R<sub>1</sub> represents:




(R<sub>2</sub> represents H or Me))

( II )

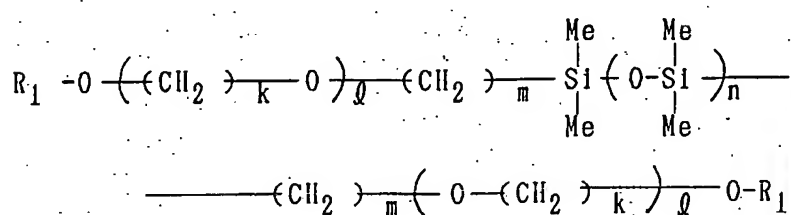


(in the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, p + q represents an integer of 11-139 (however, p ≥ 0 and q ≥ 0), Me represents CH<sub>3</sub>, Ph

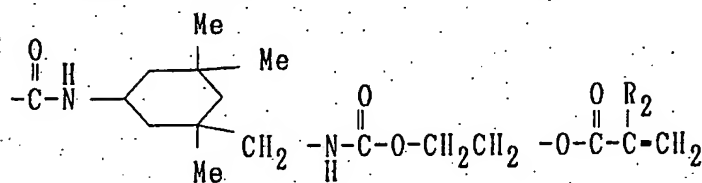
represents , and R<sub>1</sub> is the same as in formula (I)).

- The contact lens material of Claim 1, characterized by the fact that the molecular weight of the siloxane oligomer represented by formula (I) or (II) is 800-6,000.
- The contact lens material of Claim 1, characterized by the fact that the ratio of the siloxane oligomer represented by formula (I) and/or the siloxane oligomer represented by formula (II) included in the monomer mixture for the copolymer is 0.1-15 wt%.
- The contact lens material of Claim 1, characterized by the fact that the monomer mixture for the copolymerization is composed of at least one kind of (meth)acrylate containing fluorine and at least one kind of siloxanyl (meth)acrylate as essential components.
- A contact lens, characterized by being formed by working a copolymer obtained from a monomer mixture of a siloxane oligomer represented by the following formula (I) and/or a siloxane oligomer represented by formula (II) as essential components, as well as a contact lens obtained by working the above-mentioned contact lens material:

( I )

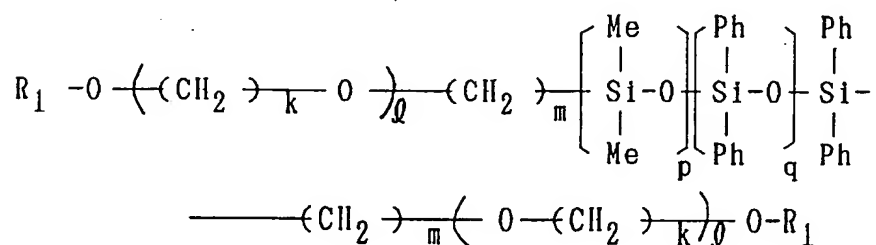



(in the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, n represents an integer of 9-199, Me represents CH<sub>3</sub>, and R<sub>1</sub> represents:



(R<sub>2</sub> represents H or Me.)

( II )



(in the formula, k represents an integer of 1-3, l represents 0 or 1, m represents an integer of 0-3, p + q represents an integer of 11-139 (however, p ≥ 0 and q ≥ 0), Me represents CH<sub>3</sub>, Ph represents , and R<sub>1</sub> is the same as in formula (I)).

6. The contact lens of Claim 5, characterized by the fact that the molecular weight of the siloxane oligomer represented by formula (I) or (II) is 800-6,000.
7. The contact lens of Claim 5, characterized by the fact that the ratio of the siloxane oligomer represented by formula (I) and/or the siloxane oligomer represented by formula (II) included in the monomer mixture for the copolymer is 0.1-15 wt%.
8. The contact lens of Claim 5, characterized by the fact that the monomer mixture for the copolymerization is composed of at least one kind of (meth)acrylate containing fluorine and at least one kind of siloxanyl (meth)acrylate as essential components.



## INTERNATIONAL SEARCH REPORT

International Application No PCT/JP90/01736

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl <sup>5</sup> G02C7/04		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC	G02C7/04	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT *</b>		
Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	JP, A, 61-138613 (Toyo Contact Lens K.K.), June 26, 1986 (26. 06. 86), Lines 4 to 19, upper part, right column, page 6 & US, A, 4,649,184 & EP, A2, 184800	1, 5
<p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
April 1, 1991 (01. 04. 91)		April 22, 1991 (22. 04. 91)
International Searching Authority		Signature of Authorized Officer
Japanese Patent Office		

Form PCT/ISA/210 (second sheet) (January 1985)